Notebook Series -- Notebooks by Edison and Other Experimenters
Disc Plating Experiments
Notebook, N-20-06-04

This notebook was used by Edison during June and July 1920. The entries pertain to the plating processes involved in the manufacture of disc records. Included are notes and drawings on a variety of electroplating experiments, among them trials with different plating solutions, plating equipment, current ratings, and methods. The experiments include attempts to design an anode for the copper plating molds and a mold holder. Additional experiments relate to the ingredients of the copper solution focused on the specific gravity and temperature. Also included are reports and calculations regarding record mold electroplating production schedules. In addition, there are detailed descriptions of production methods and work in the Graphiting, Plating, and Anode departments, along with a description of the procedure for receiving, storing, graphiting, and copper plating wax disc record masters. There are occasional notes about matters to be further investigated and suggestions about improvements or solutions to current problems. Beginning on page 124 is a list of fifty-two "Things to be Inspected" during the course of production. The last page contains a list of "repair work" to be done. The notes indicate that Edison was assisted by James M. Burns, F. Detlef, Jr., John McMullen, Sherwood T. (Sam) Moore, Frederick P. Ott, and an experimenter named Stout (possibly Frank M. Stout). The front cover is labeled "Disc Record" and "Sub Plating No 1." The book contains 134 numbered pages, some of which are blank, followed by 6 unnumbered pages of notes. Approximately 100 pages have been used.

Experiments June 4 1920 /

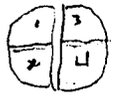
New Cast Copper anode put in the saturated $CuSO_4$ sol.
8.2 Volts at bus bar.
Could only get 2 amperes on am meter — Rec Carbon removed from circuit —
8.2 Volt across bath terminals — held a piece of old ½ worn Cu anode in sol — I touched new anode it jumped to 20 amperes, showing new anode coated with red cuprous oxide —
Took out anodes — filed surface of new anode put back — 8.2 V + 16 to 18 amp — Kept around 18 amp all night. 12 hours

Solution used 20 gals water saturated with $CuSO_4$ at 80° Fahr — filtered off & added 2 liters strong sulphuric acid

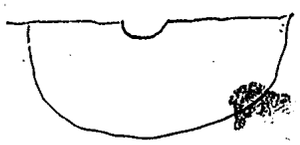
found in, adding Acid it
Salted out some crystals -
Added after solution Cooled
to Room temp 80°. 1 gal
water, still Crystals, added
another gal - found in
Morning Crystals on rotating
disc added another gal.
All together 3 gals -
still some Crystals ——

From this think we should
determine formula if a
Saturated sol at 55°
which is as low as plating
Rooms ever get.

I sawed a Cu discard in
4 parts



Made 1 section Anode gives
18½ amp - I am pulling it



test –

A test with 040 hole
yet clean across
micro pressure
3" of Mercury
= 6 lbs pressure,

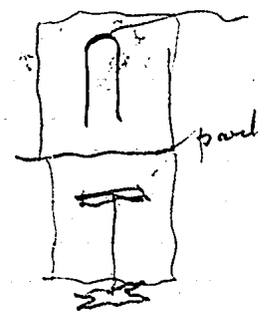
in for ½ hour to see if Constant,

a preliminary test holding
1/4 section in anode Depth
by hand –

		amp
When 3/4" from partition		20
" 1	"	19
2	"	17½
3	"	15½
4	"	14½
When farthest away or 1/4" from back		12

This is fine with such a
small area anode

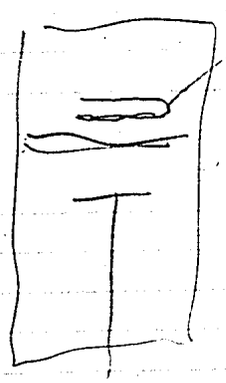
I now bend a ¼ section this



With 18 amperes + $\frac{1}{4}$ section of Disc as anode
Removing cloth partition made no change still 18 amp showing clean cloth no change — Rosenheim

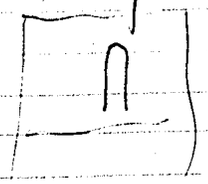
The $\frac{1}{4}$ section of Green used greasy + gave 18 amp but when cleaned of grease by Kcy. washed + put back gives 21 amperes — $1\frac{1}{2}$" away from cloth partition

Hout put 2 centrifugals in series but the 25 gave no more output per min than before. No change could be detected altho Worthington's Engr said it would double the pressure



1/4 section bent wings 1/8 apart flat curve $1\frac{1}{2}$" from cloth partition 17 amp

Edgewise gives 15 amp



In old Copper anodes
The part facing disc is more than 3/4 gone back very little Eaten, No holes in to allow of back being utilized

The double cloth diaphrms when put in stick up one side or the other, But can put them in anyway The pulling on of Cover Evens them up.

I put in 1/4 section flatwise Connected at 1½" from Cloth — Cyanided 18½ amp — in at 12 35 pm for a run to see if changes at 1240 dropped to 10 amp

This shows all previous test held in momentarily are NG — Evidently 1/4 section too small to take the current + polarizes

1242 —	2 amp.
1250	3
1255	4 1/4
1 pm	4 3/4
105	4 3/4
110	5
115	5
120	5 1/4
125	5 1/4
130	5 1/4
330 pm.	4 —

4 pm look out

Covered with black oxide Copper showing too high density + formation free oxide

Cu_2O

Washing Jet for Nickel bath

Should test on 040 hole covers
whole of Music should test

040 hole	2 minute 0 sec	500 CC	4 lb pressure
035	2 " 55	"	4½ "
030	3 " 45 sec	"	4½

only 040 covers music

040 4.166 cc per sec
035 2.800 "
030 2.2 "

040 360 Liters per Bath 24 hours
4 lb pressure

200 baths 72000 liters or 18000 gals
200 anode " " 18000
Total gals - 36000
1500 gals hour

Each bath fresh solution every
24 minutes

This is more than ample
once hourly would be enough

McMullin took a Cu Discard
took it to treatment Room —
Hydrogen Cleaned at 8/4

Put it in Nickel bath 5 amperes
Covered OK in 1½ minutes,
So if Ni flash on all record
Matrix is 5 min it will be
ample —

Fred Ott with Mercury gauge
finds 040 jet with 2 3/4
inch Column covers whole
of Music
If 1" Hg Equals 8 oz then it
gives pressure of 22 oz
or 1 lb 6 oz —

Fred made a mistake it is
3 + 3/4 inch Hg. or
30 oz pressure —

7 PM	15.50
8	15.00
9	14.75
10	14.00
11	13.50
12	13.00
1 am	12
2	11.50
3	10.50
4	8.50
5	7.00
9	6.50 — at 8 30 put in gal water 4 gal liquid
9 30 am	7.50 — been put in from
9 45	7.75 — start —

Took out Anode, its 3/4 covered with green probably crystals but slimy — washed it & put back

9 50 am	17.5
9 52 "	18.0 — Specg 1.210
10.10 —	10. temp of Solution 79 in Crock 82 in Bath

cooled crystals — after that dissolved off very slight red scum — washed off & put in bath

10 25	18.

10 26 — put in 2 gals water in the Crock.

10 40 —	11½ amp — Specg — 1.180
11 15	13½
11 40	14 3/4
12	15 — Specg 1180 —

Now put in 2 gals more. now 5 gals over the original 20 gal.

Carried forward to page 23

Reg Cu discard weight — 1 lb 3 oz — Say 20 g

6p disco — 12 halves as anode probably give 3 to 4 new discs before scrapping Day B.

Now put in a cast Copper Anode with support straps cast in. This has had surface filed off both sides — but 1 side has Cavities & this had to face disc & its only partially filed —

4 45 pm - 19½ amp

Average amp hours already plated on this previously 16.4 amp for 14 hours | 226 amp hours

- 5 35 pm 16½

see opposite page

Note:

Our Reg Cu Sol
is kept Spec G 1.145 to 1.150
Try Keep at 1.150

Sol on account of Recirculation
tends to heat up. so they
pass solution thru Coils
surrounded with Cold
Water to keep temp down

Better investigate

Rough Calculation shows we
must handle 500 Dips per day
average for Reg dip 5 mins then
ready for Varnishing - For Redips
4 minutes
If we call the cycle 5 mins
Maximum 288 Dips 24 hours
per Cleaner + 8/4 section - assume
250 only - 85 on a shift 8 hours

If we put in 3 Banks we get
750; while only 500 wanted

We then have time for Varnishing
2 Coats - on on redips already
Coated, a recoat put on -
Recoats 3 hours - + Reg Coats
3 hours 1st Coat 2 hours second
Coat

If we congest 80 Disc in this
dept always we get above
drying time — Hence
Racks for 80 wanted -

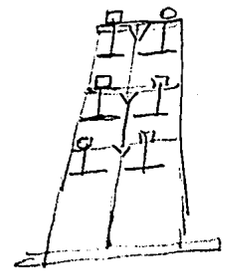
Note! ! !

If we use 1300 Cu baths
With 1/4 section built up sections
for anode we need 1440 KWH
daily — if costs 1½ cents KWH
it is $21 dollars a day
~~but~~ over Cast anodes, for when
built up anodes are used we get
25 amps with 9½ V where if
Cast anodes used get only
20 amps — & 260 baths
less or only 1040 Baths.
necessary & no impurities
brought in —

I will try Working Model built up
anodes with Ni on to see if OK —

If can deposit ok with 20
amperes only requires 43 hours for
a dose — & 860 Baths
If 24 amp can be used requires
only 36 Hours & ½ the baths 700

Racks



Music down

Vary up best for drying & music down
best on account of dust —

June 3 1920

Report

Mould holders on hand

Good	2091
To be repaired	1320
Rings OK for use	113
Bottom plates part finished	105
Master Mould holders	116 OK

6400 records pressed daily needs 80 presses - these hold 960 Record pair 1960 - Mould holders hence the other holders should be repaired as we should have 20 loads Extra this is 440 Mould holders -
Total 2400 actually needed leaving 1000 for assembling room & spare for block
Luhr says can repair the 1320 quickly 20 daily

At plating plant Mc tells me they keep temp of baths down to 74 to 78 by cooling coils thru which cold water runs these coils are under mechanical table —

I think no solution of bath is changed Every hour Coils should be put out one Central point say at Cracks —

also think we should have filter pressers

Walter has increased diameter of his slip plating jar to 7½ inches slips 6 inches apart powerful stirrer

2 inches surface area density of 1½ amp per sq inch 8 hours

gts OK - weighs 17.85 grms

Dobanly feeding warm than room

Callipers .030 —

Continued from page 17

226 amp hours already on

1 pm	17	amp - 1.165 Spec G.
1 30	17	
2	16	Spec G 1170 "
2 32	16½	Spec G - 1.172
4.30	14.34	" 1.175

Temp in Crack 85° Tanks all grms

6 pm	15	Spec G 1.175 Temp
12 Midnight	14½	
4 am	15	Spec G 1.180 Some evaporated
8 am	15	

Temps Crack during night 80 @ 85

The new rubber washing jet put in 4th June 3 pm + adjusted — OK now 5th 9 am without touching or adjustment

S

* we should keep it at 1170 by adding water — added ½ gal water at 850 am + run for ½ hour

See next page —

Nicolai Electrician went over & measured several Cu baths for drop of Voltage across terminals Varies from 4 To 6 Volts –

See 23 page X0 | Cast Cu *

June 15th –	Spec G	V	Amp	Color
6 pm				
9 "	1180	9½	15	
12 "	1180	"	16	
3 am 5th June	1170	"	18½	88
6 am – "	1170	"	19	88
9 am "	1175	"	18½	85
12 Noon	1175	"	18 3/4	80
4 pm –	1175	"	20	86
6 am	1175		19½	86
10 am	1180	"	18½	81
12 " noon	1175	"	18	90
2 pm Sunday June 6th	1175	"	18	80

3 35 pm Sunday 6th

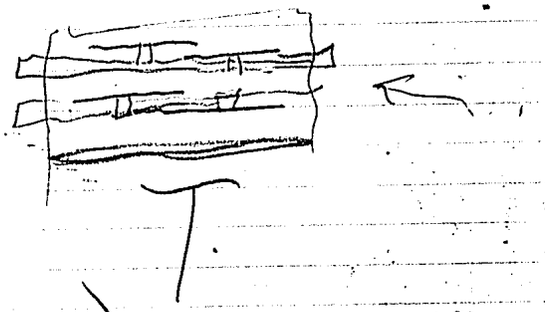
Removed for stripping

Put in another.

See p 49 =

Keeping Cast Cu filled anode in –

Note 7.8 on line +
with 30 ampere on here
2 cells – Here 7.3
Drop of .5 of Volt
for 30 amp
amperes off reads here 7.7



staggered

Started New Bath, 4 ¼ sections of Cu deposited – Connected One ¼ section, started at 16 amp in 15 minutes dropped to 9 ¼ amp showing density on this anode too great,

Connected up another ¼ section, Went to 19 amp

1.40 pm –		
1.46 "	15	¼ one
1.55	15	Zero
	16	3 ¼ sec in
1.56 pm		
2 pm –	15 ½	
2.15	15 ½	~~speeds~~

No 2 Bath

2.18 pm	15 ½	4 Sections in
didnt raise amperes –		
3.32 pm	15 ½	
4.35 pm –	16 –	
9.00 pm –	16	
12 midnight	15 ½	
4 am	15	
8 am –	15	

See page 43

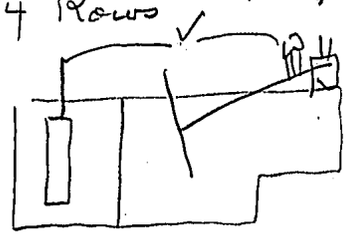
28.

Note D'Elles – on rapid plating
~~found~~ on start Spec Grav of sol
1.135
at End of run 1.180.

How did it raise —
Find the reason
Besides Evaporation

Bus V 7.5 not certain 31

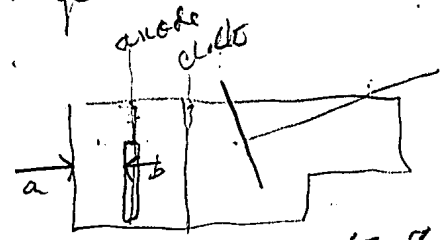
Beldings Man made some measurements on V + amp of our Cu Baths in 4 Rows



Bath	V	amp	
173	2.9	7.8	No 1 Row
177	3.2	8	
138	3.4	8.3	No 2 Row
139	4.6	11.6	
144	4.4	9.8	
146	4.9	9.5	
88	3.8	10.7	No 3 Row
89	3.9	11.2	
90	39	11.1	
65	4.6	11.8	No 4 Row
66	4.4	10.3	
67	5	11.8	
		10.5	8.5

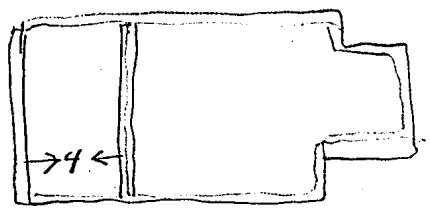
Says his Amp Meter reads 2 amp to high

Beldingeman bread thin



a + b	3.6	inches apart	8.7	amp
"	4.4	" "	10.3	"
	5.3	" "	12.2	

If anode is advanced towards cloth partition 1.7 inches the amps increase from 8.7 to 12.2



Thickness anode cast 1 3/8"

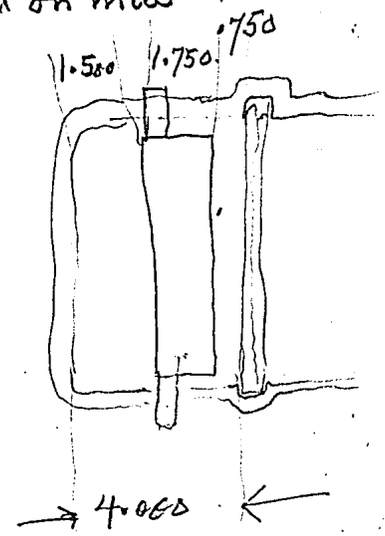
Evidently anodes should be as near screen as possible,

Weight of Reg Cast Anode Copper
$16\frac{1}{4}$ lbs

This weighs
$11\frac{1}{4}$ lbs

From Cast probably can pick off 3/4 or 190 oz of Copper
Each discard weighs 20 oz
Cu — 9 — Copper discs
or backings —
Probably 6 from Multiple disc plates

The anode lugs should be Cast on thus



Possibly anode will Cant when new, + may left Cover a little = try it

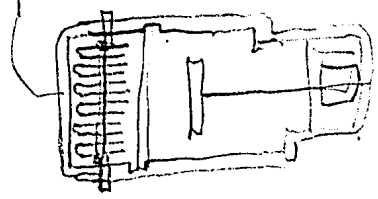
We now control Generator feed by Rheostat in Experimental Lab

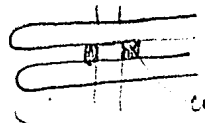
Think we should have a jack for amperes so man can walk along + shows in tread amp-Volts not necessary - Possibly 1 big amp he can see all over room + a Duplicate -

All Copper discs

We now start a Third Bath 3 Bath

With 1/2 sections of a Cu discard threaded on a rod with washers occupies almost whole of Anode Compartment





1/2 section bent thus

washer -

Record In

	Bath V	amps	Gradients
2.20 pm June 5th	8	21	
250	8	21	
Now 10 Volts on Bath	10	25	
305 - 9 1/2 "	9 1/2	25	
We'll keep it all night.			
3 pm	10	26	
6 " Spec G 1170	9 1/2	25	88°
8 " 1175		24.5	
10 " see next page 1175		24	85

No 3 Batt

	Spec G	Buss Volts	Amperes	Crock T
12 Midnight	1175	9½	24	80
2 am 6th June	1175	"	25¼	85
4 am "	1175	"	26	86
6 am "	1175	"	25½	88
8 am "	1175	"	24¼	86
10 am "	1180	"	23	81
12 Noon "	1175	"	23	80
2 pm "	1175	"	23	80
7 " "	"	"	24	80
10 " "	1180	"	23	80
12 Midnight –	1175	"	23	80
2 am June 7	"	"	23	85
5 " "	"	"	23	80
9 " "	1170	"	22.5	82

Out 1145 am June 7 1920

4 1/4 Sections -
Made by Burns

	Sp.g.	V	amp	Crock
Started on 4th				
2.20 pm -			15 1/2	
4 pm -			16	
6 pm			16	
9 "			16	
12 midnight -			15 1/2	
1 am - June 5			16	
4 " "			15	
6 " "			15	
9 "			15	
11 " "	1170		16	86
12 " " moon -	1170		16	86
2 pm	1170	9 1/2	16	86
4 pm -	1170	9 1/2	15	84
7 " 2 Sections taken off	1170	9 1/2	11	85
10 pm		9 1/2	10 1/4	
11 —		9 1/2	8	
12 midnight —		9 1/2	9 1/4	
1 am 6th June		9 1/2	7 1/4	
all Eaton off				

About 1/2 of one quarter Section left.

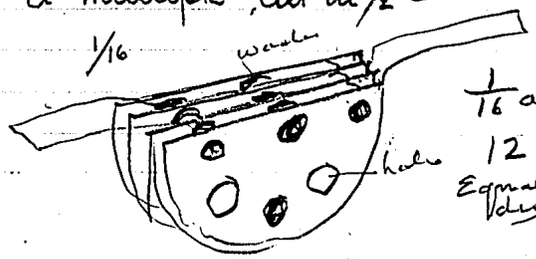
Eatkins -

51 Bath hours at 12 amp per 1 Disc -

Certainly Can was up 80% or more

Friday support lugs
Eaten off — Due to
flooded apartment —
too much liquid put
in —

Started in No 4 Bath
a multiple Cut in 1/2 —



1/16 apart
12 ~~1/8~~ discs
Equal 6 full
discs

	Sp G	Volt	Amp	Crack T
8.15 pm 6th Sunday	1175	9.5	24	80
4 30 "	1175	9.5	20 1/4	80
5 30 "	1175	9.5	20	83
8 — "	1180	"	25	80
10 pm "	1180	"	20.5	80
12 Midnight -	1175	"	20.5	80
2 am June 7th	"	"	23.	85
6 " "	"	"	23.25	80
9 " "	1170	"	22.25	82
12 ~~pm~~ midnight -	"	"	24.5	83
2 am June 8	"	"	23.5	83
7 am "	"	"	21	81
12 noon "	"	"	22	82
5 pm	"	"	23	83

Taken out
864 amperes
OK —
Callipers 066

4 Bath – June 8 1920 47
New drac peet in

Spec G	Volts	amp	Cir T

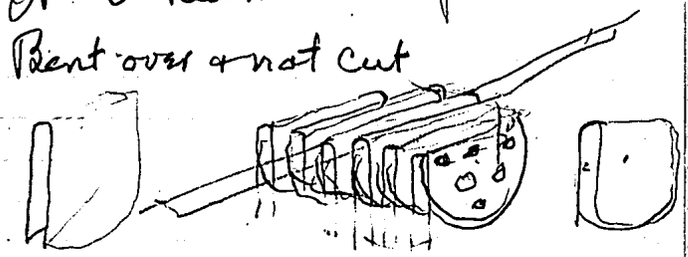
In Bath No 1

Dame anode - 1 Disc taken from it

Thes-is 2nd Disc

	SpecG	Volts	Amp	Crock
Sunday 6th				
4.50 pm - "	1175	9.5	20	—
7.00 "	"	"	21	—
10.00 "	1180	"	17.75	—
12 Midnight	1175	"	19.5	—
3 am June 7	1180	"	19.5	—
6 am "	1175	"	18	—
9 " "	1170	"	18	—
12 Noon "	1170	"	21	—
6 pm	1175	"	17	—
12 Midnight	1170	"	16	—
6 am June 8	"	"	18	—
12 Noon "	"	"	17.5	—
1 pm	"		17.5	82

NO 5 Bath - is 6 full discs
Bent over & not cut



This makes 6 full discs bent & not
Cut in 1/2 like that in NO 4 Bath.

On 4 45 PM 6th/mo	Speed	V	amp	Crack	
4.45 PM	1175	9.5	24		
7 "	1180	"	25		
10 "	1180	"	19		
12 Midnight	1175	"	23		
3 am	1180	"	24		
6 am June 7th	1175	"	22		
9 " "	1170	"	21		
12 " "	"	"	22		
4 am June 8	"	"	20.25		
10 " "	"	"	20		
7 PM "	"	"	23		

Taken out
Calliper .068"

No 5 Bath –
2nd Disc put in

Spec G	Volts	Amp	Temp

With the 040 jet if not sticking disc squirts out over 10 ft showing great crushing power

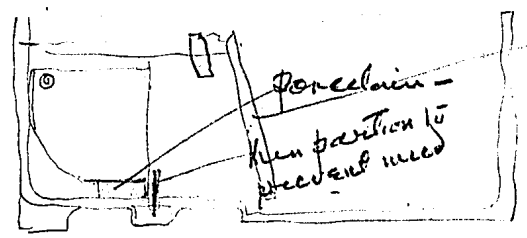
When the disc gets nubby on outer rim the nubs scatter the solution over rubbering [illegible] must put up a shield

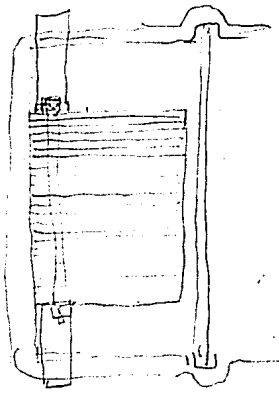
One disc went 19 hours another 25 hours before nubs got large enough to scatter the liquid

Just come from Dinner found supports of plate candle eaten off — Cause apartment flooded, liquid nearly overflown & partly covered this support

Reason is that regulating cock wide open & flow more than cloth could filter through — Must have definite hole 040 or either open or closed cock

or 18 hours 20 amp
at 360 amp having Cryolite
details 3/4 inch at Edge
generally but not Enough
to prevent liquid washing
jet from going to Edge





Think Can use solid anode
of 1/4 Sections using a porcelain
rest on Gallon Covering a
Considerable Area so as not
to bend rubber at Gallon

The only fear is The flower
Copper float over

and get on second will make Mubo!

All I found in bath after 1/3 of 1/4 section anode Eaten away was excessively fine Metallic Copper — This settles in water in 5 min most of it 1 min —

The thing to find out will these Cu pieces form nucleii for Mubo.

Think best is going to be the Nickel basket filled with pieces of disc cut by machine so all will not be parallell

Etc

June 14/20

For 3 days 6 Rubber jets only 1 choked a little

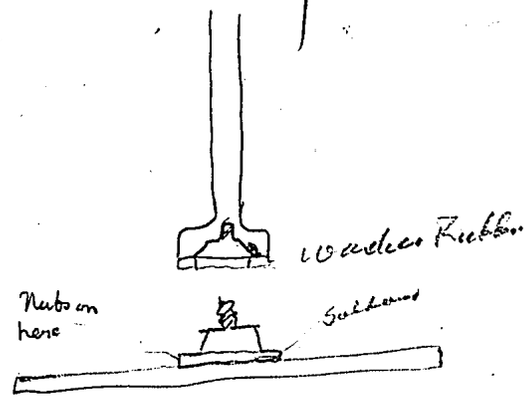
The original jet 5 days not choked

This jet is a success & will be made standard - 040 hole under pressure sufficient to throw stream across even a wavy outer edge -

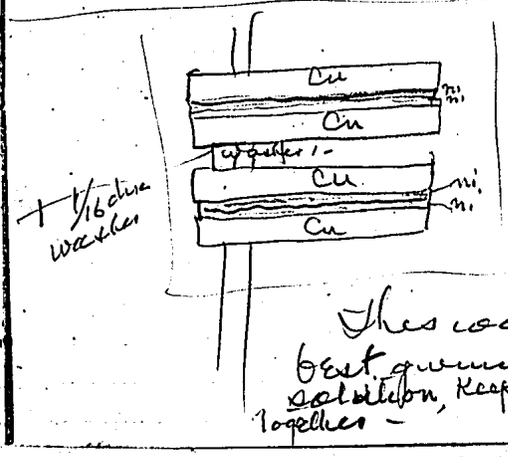
We should get in a different colored cover when holder needs Repair -

June 10 1920

The holder made by Moore



Came out without any leak then rubber washer - so far its a success -



Here one in wkg now

This would be best giving access to solution, keeping Ni's together -

[633]

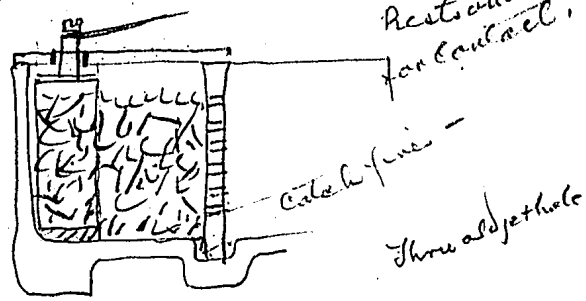
Experiment on washing off finger marks, having a trace of Lamp black to make conspicuous — Washing at different temperatures also times —

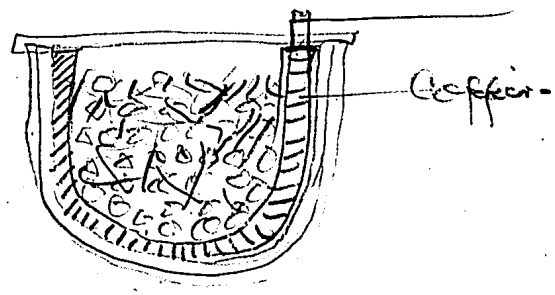
Try Experiments with gloves & also fingers —

Must have standardized bells diameter right to grip the [V] also a fastner that will adjust the length easily & quickly without twist if possible

First Experiment with Nickel Basket front face Eaten away — This shows Mechanically Roller Ni will not stand in acid Copper bath near the Cathode

its probable electrolytic Ni would stand for a time but for a sure thing Ni baskets will have to be abandoned





Copper wire wound to get minimum weight.

One advantage of this is cheap + simple + smaller area from anode towards

the disc which reduces deposit on edges.
probably the weight of Gallo get too hot wide alongside the Rubber — but if backed up from the table & lined up it will prevent this —

As there are remarks about Crystalization at 1175 & 1170 — 80 to 83 degrees, I think we shall have to weaken the Solution a little.

Tried scraping off nuts with end of white pin stick. Comes off OK 2 minutes angle — It takes off ~~almost~~ the Varnish where nuts removed. Many Can be fixed by varnishing the nuts places but where nuts bad must be revarnished all over. The 2 9 dry the Varnish dry & hard —

Wax Records handled June 15 1920

Come from NY in Tin boxes - sealed up, 12 put in box & shipped by Calls or other Express - McCsaw box if rain get on would prbly be bad No 3. Wax record of the time is always brought over by Merchgr. The box to No 3 Delivered to Vault.

Grafoling Dept gets orders to take out get orders to take out every day except Saturday - 12 at a time All are taken out as fast as they Collect

Taken to grafoling room - in this room an Eye inspection made for imperfections by Dempsey & McM brother They dont talk when inspecting - if defect found to noted held to Carbon Walter Miller when he comes over only few, 1 in 6 months

Number put on - taken out box blow off with Compressed air Air screened from Cotton, Cotton cleaned once week - Nozzle has Cotton also -

Put in grafoling Machine - 3 men to grafite, 1 can grafite on hand last 1 yr

Grafite made by us Golf does it. Find out more about this & test it -

Holes are drilled in wax blanks at Silver Lake before sending to NY

Dempsey & McC put pens in wire up Look under Micro side of OK just a drop test -

Take it down to plating room — Lay it down & blow it off with Compressed air, from same source as up stairs —

Put on a Feeder —
Put in bath —

Starts 1 amp.
when 3/8 Covered 1 1/2
" 1 " 2
" 1 1/2 " 2 1/2
" 2 " 3
" 2 1/2 " 3 1/2
" 3 " 4
" Music Covered 5
Label Covered 6
When all all Covered put at 8 amp. Then 1 amp Every 5 min up to 15, Then leave in 4 hours.
Then transferred to Final bath for 96 hours 12 amp

Temp ~~Room~~ Baths 74 to 78.
Specg 1.150
Only day shift do 12 every day —
Used jets,
We must study jet & more jet & determine how Chrome it is to be to prevent affecting graphite —

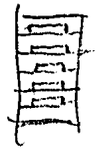
Mc says Master is larger than working Moulds abt 1/16 —
If holes not drilled cannot make new pair of holders & Master cannot be larger
Investigate —

To Twin edges 90 days
total cycle 7 min —

Stripping ½ min but machine
mould etc put in boxes etc
4 minutes,

Days all masters have hole
closed - done upstairs
also ring put on —
Days. We shall need more
Vault room right away as
masters etc now require a
box. unload of the thin tin
holder —

I tried 75 parts $CuSO_4$
mixed with 25 pts $NiSO_4$
The Copper plates out fine
strips OK + it seems to be
Excessively soft not a
trace of spring to it
more like Lead

What we need in handling is
Hardwood benches. 2" stock -
also  of thicker wood
& hard wood

Men to clean all the time
nothing laid around.

Plating Dept in 24 Bldg have
trouble with pumps, air,
gets in tanks should be raised
or pumps lowered to prime
the pumps thoroughly —
also Extra pumps arranged
to scrub in in Case
accident,

In our Nickel bath in Expt Dept
We have approx 6 gals
$NiSO_4$ — it peels on edge
after a while — I will
put in acetic just enough
to make full acid to Litmus

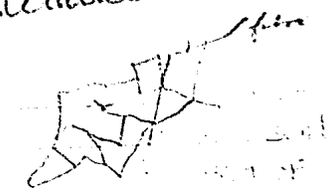
as I think it is necessary to keep up in solution a precipitant attacking the brittle

I tried wiping the 6/4d Copper under water & also in air with finest quality of sponge It dont harm surface but after cleaning Electrolytically if sponge rubbed over vigorously. The surface gets scratched lines where sponge deposits something upon itself on music & which water dont wet

Cant use sponge

Try silk under Micro Sponge has sand particles

Even the highest grade —
Sponge is locked together
animal matter fibre



I find that the 8/4 on copper
if drop blue is removed by
using Cathode in Cleaning
Tank. 5 5
1 1

I find MacM hydrometer
Reads 1255 + floats
Read 1270 Evidently
should have 2 standard
hydrometers in a case
& all used hydmtrs Checked

In Plating Dept they rub
off the Nubs after plating
but they come off hard because
they varnish before putting
in 8/4 —

Whereas if they varnished
after 8/4 they could
brush off & probably
not break off varnish —

Detter is trying Export with
Nickel faced slips cleaned
& put in 8/4 ~~from~~ 1 min
strength from 1 min to
2 hours — 1 2 3 4 5 + 6

4+5 stuck on 5th run = 1 2 3 + 6
OK — I feel sure I failed to
dip 4+5 after cleaning
So far 8 times OK strip 1 2 3 + 6
OK — clean 20 sec dip 10 in 1 min
8/4 — for further infm see ahead

with acetic acid just red to litmus
105° 7 hrs in Bath - deposits,
gray - perfectly flat after stripping
no peel patches 49 amp -
Removed - peeled perfect,
There was enough Ni hydrox to form acetate Ni
in bath
Put in another think it was
Copper disc - put it right on
at 7½ amp - put it to 8½
amp after 28 min went
to 9½ probably burned
by heat in bath - now 104 °Fah
The disc run 13 hours all
together, 11 hours it was
10 amp - 2 hours 9½ + 8 amp
on start, 9½ volts - Caliper .010
By plating 10 hours
at 9 @ 9½ amp get
90 hours which weigh
68 OK - We should
try for 10 amps 10 hours
or as near that as
possible

The disc was perfectly flat.

Weight of feed anode

7½ lbs

Copper pieces 16 lbs -
This is weight 16.4 lbs of
Cast anode
Reg Cu discs and .051
weighs 1 lb 3 oz -
The above is Cu pieces
not twisted as much
as ~~any~~ the 3 previous
baths

I notice when I put a Ni strip in 1 Min S/4 for 15 hours that holes are Eat in face some round others irregular

This looks like dirt on surface of liquid & when disc is immersed the film is drawn in Contact with the face of the disc & covers it — as the float stuff is porous it plates thru it but plates spongy & the S/4 Eats it

We could blow the surface & we now have a place in Rubber baths to do this

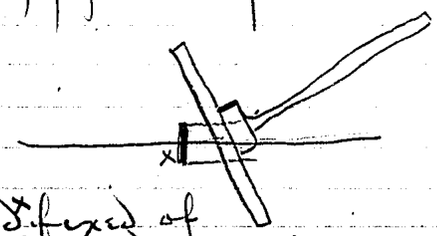
This may not be sufficient if a 2nd disc was put in same time in advance say 1/8 inch it would take the film off on withdrawal from bath

would carry film with it

Also when notching the films formed on surface must be carried down Continuously

These films I am sure is the cause of only printing 500 before getting rough — if they were Eliminated I should get 1000 or more

Another bad thing is our Solutions are cloudy they are never clear & these Colloids including Formic hydrate get on disc & give up the spongy plating



a band fixed of Rubber would stop films getting on

We must have filter press for Nickel baths more efficient
have a skimmer to strip films, ~~perhaps~~ ~~[illegible]~~ of a 75 @ 100 lbs pressure so it filters through undecomposed mud.

Perhaps must be lubricating unmixed - but then gas bubbles

Possibly Fullers Earth to clarify from Colloids & filter press —

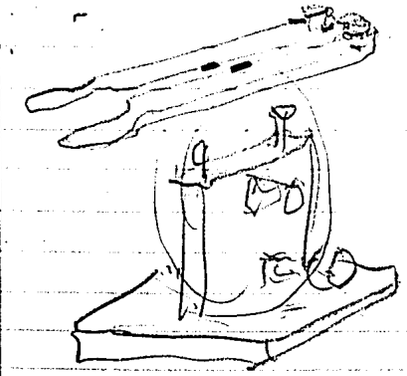
The faster it plates the less chance of getting Colloid Clots & less spongy if gas dont unmixed —

5

I am dipping 5 Ni strips
Clean all 20 seconds —
Dipping 8/4 20 seconds

Thereafter no cleaning but just dip all 10 seconds in 8/4 —

These are all in one bath
3rd Crystal NiSO4 - 3 stripping
none black to Ni but 3rd stripping - all Tors 2nd all but 1 Tors 3rd stripping 3 Tors 3 OK
I cleaned one by mistake & discarded it



Works OK

0021

Be sure we put grease cups on shaft bearings so oil will not run along shaft get on belt & often throw off rest on table & have oil washed down in trough

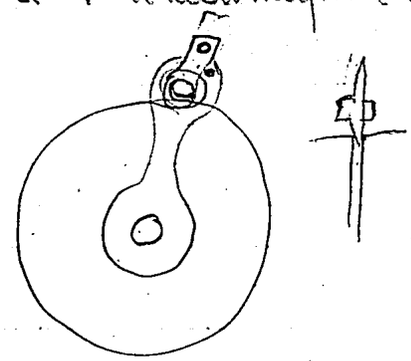
Wood might be better — pure Babbitt — get rid oil allogether

Fix bearings on pumps so no oil can get in

The knife separator for forcing apart the 2 disc works OK on the Moore holder but some of the old holders not turned down enough & its troublesome to run wedges in & seperate. Moores is true & seperates with the greatest ease.

Moore will put machine in good shape for practical work.

Think instead of wooden wedges a V wheel might be better



It will only hit Edge

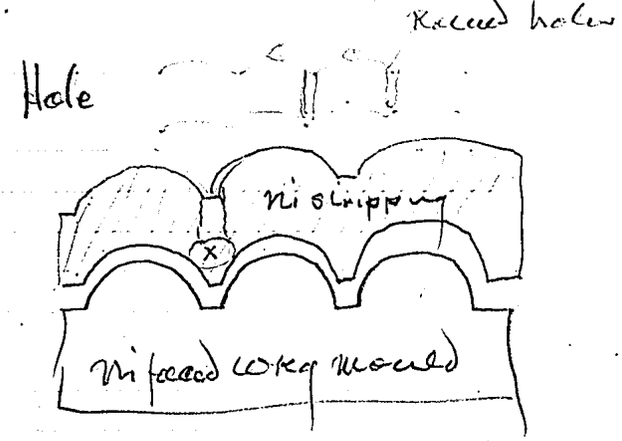
Note

I have now put a skimmer in the Nickel bath, The jet is not being used with the skimmer

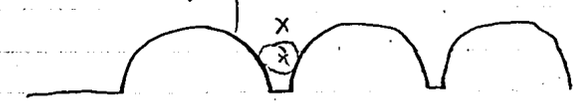
The Ni plated without jet or skimmer was very warty, Mac noticed when he put it in & it started rotation lots of particles on the surface went to the Disc & clung — But when we put skimmer on none were noticed This skimmer may be a very good improvement to produce quiet record.

On looking at rough side of this stripping it confirms the other one which had not jet There is scarcely a hole in the Music — both rough surfaces have same crystalline appearance & quite different from those with jets on — However the smooth part of Edge has many gas holes just as the one without jet or skimmer

The Nickel strippings .008 to .010 with jet (Rubber) .040 hole. I find full of minute holes when looked at in microscope on rough side.



Bubbles all about same size get into bridge wall recess of working mould



+ cling to it all through

Note

the plaining, under Means looking at rough side see innumberable holes perfectly round all along the bridge wall space – Very seldom is one seen on the place where ball tracks. Where the holes are very thick one is seen in track but they are very small – less than .001 whereas regular bridge wall bubble or air holes are .002 about generally all of one size –

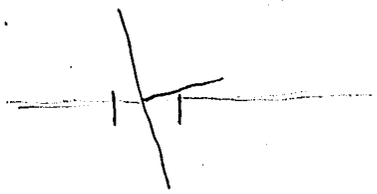
I noticed on the stripping where we did not use the jet it is difficult to find a hole

I think the jet is bad that it does more harm than good – The large amount of liquid + great force churns + puts air in the liquid making the bubbles + these attach

themselves to the disk & stay there,

I have just removed a new Nickel stripping which is the thickest yet 179½ amp hours — & it has the least nubs & is smoothest yet

This had no jet, But was provided with a rubber skimmer

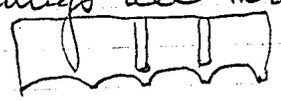


to stop surface tension dirt from running towards the disc

The one without skimmer or jet has many isolated nubs hardly a hold in music & plenty holes on edge smooth part —

It must be remembered I am using Nickel faced Working Mould discards & they have not been cleaned perfectly mechanically – Especially down in bridge Wall Canyon & on smooth part

No Holes shown on polished side –
There is 001 wall ok then the bubble attaches & clings all then plating

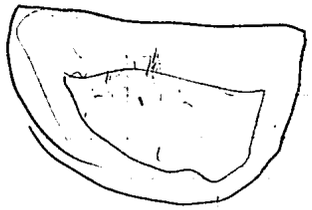


Possibly when back gets rough the bubbles can cling –

This one without jet has scarcely any wall at all nubs scarcely any holes in mould but plenty on edge on smooth part

It is probably that only the skimmer should be used & the speed of disc should be diminished so it goes very much slower

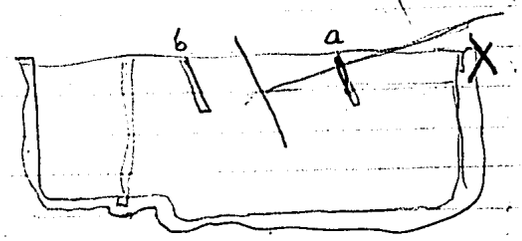
Try slowest speed by changing driver pulley driving belt to bath –
Say 2" mean driving diameter
Bopper bath 4 3/4 Rev Min in here.



Took off a Nickel. had 203½ amp hours — 13½ thousandths thick some nubs otherwise smooth No holes in smooth margin found only 2 holes in Nickel 002 on bridge wall — Very good

Had not wash yet. used skimmer —

I find the rag rubber skimmers bad as they



Collect a large amount of skum which probably comes out in gob at time I will remove them as

unnecessary = at X I wiped off ½ a thimbleful of sticky greasy oily matter where skum had washed up on sides. This would all have gone to overflow removed by filter cloths in filter press —

We must use the skimmer This must be all rubber.

The copper eats off altho not connected to current it oxidizes at junctions of the liquid & acid dissolves oxide,

The feed to anode pt must see the stream fall it should be about the center —
Notch should be in cover to remove it & not a hole

The overflow must have Copper screws in Copper baths + the screws in the bath & should be adjusted even across on Center –

If cloth separators are to be used must have porcelain as heat makes rubber bend bad The head of water doesn't

I notice our table is coming baths not level – rubber not on good – if overflow of a bath occured it wouldn't run in troth Fix it –

I really dont think we want the filter cloths They make more trouble than the do good – If our filter press works perfect there is no use for them –

I have now taken the back skim also cut a square hole thru skim next anode so surface skim runs towards this hole right next to overflow — No cloths in

Use removable Rubber Skimmer Believe this will give fine results —

We must wash & soak our Rubber baths in ~~the~~ Soda 18% to get rid of oil that in Rubber to grease.

I use a good feed into anode side —

General Inspector Can Carry a battery strapped & use flash light to inspect scums etc in Cathodes

The skimmer no partition hole thru a scum baffle — 10 @ 11 amp 100 amp hours — 8 @ 9 thousands thick practically no warts full of holes on bridge wall but back none on face this is 1st time this has occurred by skimming 3 others same conditions no holes

Noticed this disc was dirty when put in — There is some condition why the bubbles cling to bridge wall depression & not to others —

Those which show no holes show tracking disclosed whereas the one with holes ~~show~~ scarcely shows tracking on face — perhaps amperes too high & makes gas — I find what they call porous is one mass of holes ~~[illegible]~~

It looks like a scum of grease

Only 2 persons are to be permitted to fix the pumps -

Man named Jack a Russian formerly under Dimitriadis repaired all the pumps, I say never leaked no did he ever strip threads in hard rubber

Just found out source of oil in bath. All pumps to prevent leak due to bad packing have lots of tar like stuff thinned with oil clogged all wear also they use this everywhere.

Mango Pitch thinned with oil just ordered all out of plant &

Should a leak occur its to be fixed right without Tar —

I find some of the working Monel discards which I am using to plate on are discolored in spots I find this is removed by 20% NaOH solution this is varnish baked on —

I took a Nickel female that had several taken from it - had a hole put in & plugged it. I could hardly tell there was any surface dedent heard a snap in the whole - only few light cracklets

it seemed to have a matte surface in the grooves but when scraper went over it it brightened very much

from Experts with clips in to Ni + Chrome ~~[illegible]~~ 20 or more is safe —

With 1 min 8/4 strength 10 sec water dip rolling washing is OK + still going used 4 strips 2 hours 800 Mly acidic

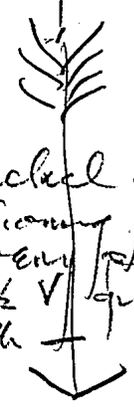
4 more : sec 5 sec 10 sec 20 40 +

2 hours — all work OK — strips in 48 hours in 8/4 OK also 48 in the Conc 8/4 wer used — Ni dont seem to flake off or penetrate at all

Whereas Copper quickly scrolls + flakes —

I have put discs in solution very slow, also almost dropped them in but this does not give bubble Holes —

I now try them putting in wet



So far the short Nickel feed anode is functioning just as well as a very porous Ni Cathode. 9½ V gives 12 amp on 6 cth —

Slate portion —

NOTICE

Have definitely discovered the Cause of holes on the bridge work, it seems strange in all these years we have

Notice

never found the reason

If a disc is put in bath after washing & still wet in full of bubble holes when looked at under, micro on the rough side They are all along the bridge wall

Canyon —
They do not show on bright or working side. because solution goes thru bubble & plates & then bridge across —

These holes in the Ni are all seen even when the Nickel is 013 thick

When Disc is put in bath Dry there is never any holes

Notice

Hereafter, after washing & final rinsed by distilled water stream the Discs must be put in the whirler & dried before putting in Bath —

Notice —

Took a slip Nickel faced, Cleaned & 8/4 washed & put in Reg OK Ni Solution put Macaloni Oil & finger & stirred Solution Then put the slip in Dry — Awful — full of Holes Bridge Wall seem

Notice

to 6z bubbles = perfectly round — Music side OK — Have same appearance as Reg disc put in Ni Solution wet, Its bubbles —

Used Reg Cond Copper sulfate & same quantity in bulk of acetic as is usual of Sulphuric in Reg solns

This makes very much finer grain in fact 038 thick is perfect & no nubs —

It doesnt give as high efficiency ~~but~~ say 80 @ 85%

Will try further —

Margin Experiment June 24/20

Made a solution of 50 parts of $NiSO_4$ + 50 parts $NiSO_4$ used Copper anode, to see if nickel affected Copper plating — Each clip 3 hours at 300 Ma — Surface 2"

Good soft Copper plated out each of the 16 Runs

This apparently shows that nickel on the Copper put in anode apparatus will not hurt the Copper plating solution as long as the Cu is predominent —

When there is 80 parts $NiSO_4$ + 20 pts $CuSO_4$ — Cu anode Copper comes on spongy

Another Margin Experiment

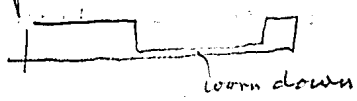
Made up a Conc Solution of 3 Crystalized Ni Sulfate, Spec G of 1300, - Just acid with Acetic Acid Plated a Strip -

Diluted to 1.280 plated strip
" 1.250 "
1.220
1.190
1.160
1.130
1.100

There appears no difference in the thickness or quality of the plating Except perhaps higher Spec G is better for nubs & may be made thicker = In practice. Should the Solution go as low as 1100 it would produce ok records but Sol would probably get hot - At about density 6 @ 7 amps on a disc We could always lower general Voltage on Baths to meet the Emergency

Suppose a Crock cracked & we lost some Solution - we could patch & dilute with water, Lower the Voltage & go ahead -

I find on inspection many idlers on bath belts are stuck & have not turned probably for 2 or 3 years - Cause use of Brass or bronze shafts on Brass idler wheel shafts worn thru



Flanges worn thru by belt slipping on stepped bearing & flanged way out -
There are many baths this way & hosts of records slop & are plated one side & lost

This should be put on Suspension list — Also steel pin used Possibly babbit (hard) Bush used

Dopper baths are coated white after washing out — Most of it is Lead Sulphate Either Comes from loading rubber with Oxide lead or, use Crystals with Lead in or something is dead lined — Actually the overflow pipe of one bath was found plugged with it Like putty — used water or Nitric acid dilute — Doughtery says mostly Lead — Notice rubber troughs see if lined with it —

Penny Orders.

1 Repair + substitute new pumps for acid on H Line —

2 = Repair system, new clamps new strongers strokes rubber Connections, or disconnected + tested before putting in place

3 40 stand and Baths brass screws — hole cut thru from inside skimmer — plated top plate — Brass screws for overflow —

4 = 40 Plate anode separators

5 = We should have one large punch Cock on big pipe over baths to Cut off liquid in Case accident + Double tubing below so if one goes the other will hold

also only use 1 stage pump for jets + 2 stage for filler presses

I have used 4 Ni faced slips + had Deller plate with Ni from 3 Crystal Nickel Sol with slight acidic. I cleaned about 15 seconds in Electro Cleaner + 10 seconds in Selenium of such a strength that it goes deep red in one minute. The 10 seconds puts Enough S/4 on to always insure perfect stripping

Plated + stripped same slips 22 times surfaces of slips just as bright + shows just as perfect under microscope as new. With this Cycle I have the slightest doubt but I could go on 100 or more perhaps indefinitely — 4 not electroconed just S/4 — 16 times one spot, that adhered .005 dia

I find on looking at working Mould discards that only tops on Mole waves cleaned that after soak 2 hours in 20% NaOH. Wiped off lots of Condensite — Then cleaning rags. Etc dont reach down in bridge wall Canyon — not even to bottom of shallow grooves where there is a high Mole —

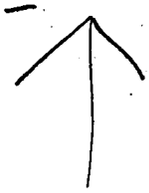
Notice around where clamped its stained bad + soda does not remove it even when vigorously rubbed — This will not plate over + is not cleaned by Electro Cleaner Must be rubbed with Vienna Lime or sand

I find that in spots on these discards is spongy places due to dirt films caught from bath when Ni 1st put in oil + dirt — New Skimmer will stop this when oil got out of system

S

I find the Rubber (soft) from overflow to outlet at Bottom of bath is so abraded that life is gone & new ones must be put in

Think Cord must be wound around —



No 1 Ni bath Reg spongy solid Ni Anode

No 2 Fed Anode Nickel.

Both worked together

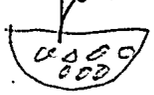
			amp
Temp No 1	—	99° Fahr	11.5
Temp No 2		96	12

I got a polished rod machine steel ½" dia ½ polished ½ left as tool I turned it Electro cleaned then about 5 min in 8/4 — 1 min strength — put out on window sill — to see results

---

We must protect our Motors from spattering of Electrolyte & also Cracked Crock.

After 15 days = June 28/20

No 5  large holes & not same area as later Screens Run 15 days 6 discs out Each 864 amp hours

Started 1st	22 @ 20	
2	19 @ 20	
	17 @ 20	
	17 @ 15	
	17 @ 18	
	16 @ 17	
	16 @ 17	Good

It went down to 15 I removed disc & took out & Emptied tank. The anode was originally 1/16" thick & was not in the least attacked. Except where it came out of liquid & this is Effect of air oxidizing & dissolving by the strong $2\frac{1}{2}$ H_2SO_4
Holes in rubber partition all open — found Extreme bottom The Copper pieces locked together by large crystals of $CuSO_4$ Our solution is too strong & must have a rubber tube to deliver jet circulating tube down near bottom to prevent crystallization & also to lower the Specific gravity to 1165 or 1160

This proves feed anode is OK part of the Nickel film Eat away think 50% will go in Sol & 50 come out in cleaning Copper perhaps less

The amount of Copper mud Extraordinarily fine was about 2 oz for the 15 days work

This mud seems to be pure Copper & fine as china Clay — I ??

Made 47 hour plating with slip $CuSO_4$ 1170 deg C $2\frac{1}{2}$% acetic acid 025 when it should be 043 thick plating perfect no nuts almost perfect just matte, a correction should be made as it more than 2" surface — its about 3 inches this would make it 033, when it should be 043

We should have dos thermometer distributed in Nickel & Copper baths & Watcher record Every say 3 hours record, & better man probably should regulate Water Cooling

Things to be Inspected - (114

1 = Jets stuck up
2 " Not properly regulated
3. Belts slack
4 Specific Grav of Cu Sol. all Cracks
5 " " Ni Sol — single Cracks
6 Acidity of Ni Sol.
7 Clear or cloudy Sol from filter presses, Nickel.
8 Ditto Copper
9 Leaking joints Set 1 2 3 4
10 - Electroalcaning Sol if Alkaline
11 Lights burning Set 1. 2. 3. 4
12 Are jets properly adjusted on Washers -
13 Time cleaning [Electro] - test 6/4 baths with Copper strip.

14 Note if men put in discs in Electro Cleaning bath with Current off. Current should not be on

15 Note if men fail to quickly turn when putting belt on disc in 8/4 bath it should not stand still in this bath for more than 2 or 3 Sec

16 - Note if men do not use their Cotton gloves -

17 - If feed anodes are kept full -

18 Note cracks in Rubber box showing leak -

19 Note if holders for Disc & shaft kept clean -

20 Note amperes on baths Ni & Cu -

21 Note Volts on baths.

22 Note if disc dryer runs true & shafts don't chatter

23 - Note if in taking discs off holder that no copper or nickel sol has got in & no plating - if found note the per cent out of Each lot you see taken apart,

24. Note if Cloth in the Ni bath is very dirty — If it is so dirty it backs up the solution in a side Compartment, notice Evidence that it has overflowed

25 When stripping is being notice say one plogen being stripped & see if discoloration followed.

26 — Note if Carefully handled after stripping & in boxes & secured so Cant be injured in Carrying

27 Note if ~~Cook~~ front of Cu & Ni are excessively wet by more than usual

28 Temp of B Ni & B Copper baths in the 3 room & temp of the general Crack

29 Note any dirty places

30 Note places they do not keep clean

31 = Note sparking on Motors & Dynamos each Dept.

32 Note any leak in roof

33 Read at nearly same time Volts & Amps on Dynamos —

34 See overflows in baths are adjusted so liquid always strikes center of disc & see if properly secured.

35 See that no loose tools screws or other things lay on baths which might fall in baths —

We have June 21 1920

1/2 printing presses & 74 Blank Presses

Stout says can crowd in 20 more printing & 12 blank – But must have ventilation in Blank press room –

Just finished plating a nickel in No 1 Ni Bath, Cast Ni anode – square hole skimmer & O. Skimmer
Total 1397 amp hours
average 11.4 amperes 9 1/2 Volts, Total time 122 hours
less volts & more than the best Copper with 500 amp –
it was a Thin record & was bowed or rather dished –
Calipers – 084
16.6 amp to 001

The No 2 is slick going now 1562

36 Note bearings of drive shafts & if belts are tight.

37 = Note state of filter cloths when removed – amount of mud on

38 = Note if leaks in stuffing box of pumps –

39 – Note any solution spattered on motors or if not properly protected –

40 Note if men in charge are at their posts

41. When inspecting any break down occurs note cause of trouble & what was done & time & if bath shaft were running –

42 = Note if idlers are not stuck on Bath. –

43 – Note Belt hook if OK

44 - Note if overflow is running evenly over whole Edge in baths -

45 - Note if solution is clear in the Skimmer —

46 See if Skimmer in right position —

47 = See if pumps have right speeds —

48. Note if right feed is working OK + adjusted

49 Notice any spattering of Solution around eight feet - it means air is in Solution, or Centrifugal is pumping air -

50 Notice any accumulation of Crystals, dust on floor, Leaks any where, a spill of liquid, Screws + Tools laying on baths -

51 = The pipe from overflow at bottom gets plugged with apparently Sulfate Lead Either from lead in the Bath rubbed or from Elsewhere in Copper Baths Inspect for free passage Can run 1/8" Nickel wire down to a mark on wire

52 Many thermometers distributed thru Ni & Cu baths & read,

This is 15 amp hour per 1/1000 — 9½ V 12.7 amp
137 Hours —

1170. $CuSO_4$ 25 cc acetic acid
Does not plate any better than Reg. with 2½ % K_2SO_4
& The Resistance is high
temp. 136° Fahr — No —

Nickel disc in No 2 Ni bath
Removed — 1741 amp hours
137 Hours —
Average Amp 12.7 — max
temp 14 — 9½ V all night
10 V. Perfect plate
About 1200 amp without
a Nub or one gram — Most
perfect plating ever done
Gas surpasses Cu —
Bright dish disc —
This has that anode =
yesterday June 30th & examined
that

Calliper
.116.
hundred & 16/thousands

.cc used

That anode functions so far
Perfect —

C4423

Oh Dear!

Slate goes to pieces in Regl Copper Solution

It also scales off in Nickel Sol- sal runs inside cleavages -

NG.

Anode Dept. – All day work

Punch discs – 1st Electro cleaning
1 removal of varnish –
final wash –

2 = Supply in box in each bldg
bag + strap over shoulder
to feed –

3 = Tank in each room to remove
a bath + wash out + put back
collection of sludge + small
pieces –

4 = Good rapid separation for
removing Electrolyte to
trough –

5 = Sheet copper 1/8 thick to
replace scrap lost + stored
up – Lake or Electrolytic Cu
foundry retained but men
used in plant if possible

Anode,

6 System of history + schedule book

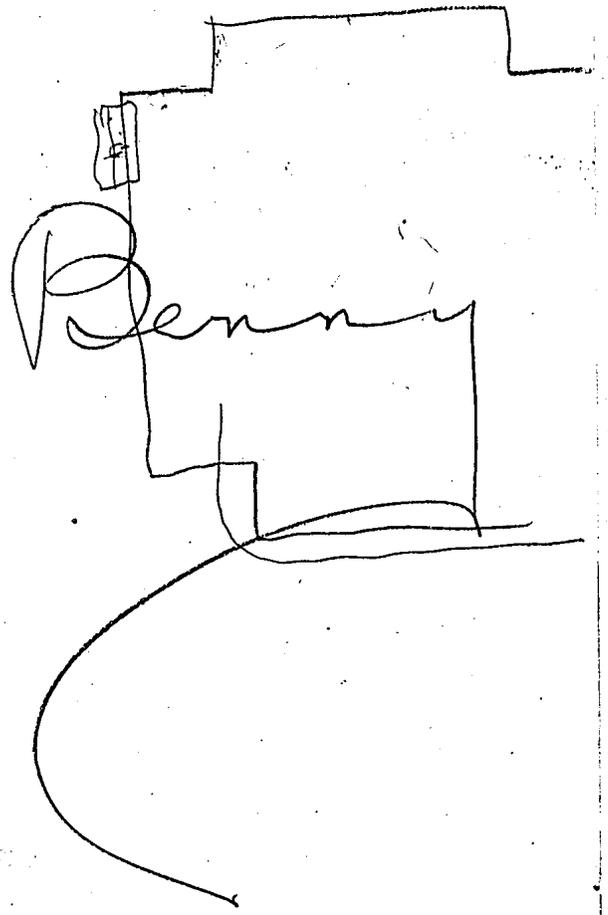
7 = Nickel chat fund,

8 Solid Cu anodes + stock kept - minimum

9 1/2 Nickel strip anodes stock kept, minimum

Repair work -

1 = Extra baths memorandum
2 " Skimmers "
3 " Tubing "
4 " glasses "
5 " Plates or porcelain "
6 " Standard holders "
7 " Overflow trough "
8 " " Rubber tube "
9 " " Screws - "
10 Feed Anode Covers "
11 Holders Control Spring "
12 Guarding legs "
13 Belts "
14 Belt idlers "
15 Corner Idler pulleys "
16 " " Holders "
17 Pumps "
18 Pump Motors "
19 Main shaft pulleys "
20 Bracket for holding jetfoil "


Penny